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ESD 13534

OPTICAL MASS MEMORY SYSTEM

(AMM-13)

CONTRACT NUMBER NAS8-33687

AMM/DBMS INTERFACE CONTROL DOCUMENT

REISSUE 2

(CDRL 004)

PREPARED FOR

GEORGE C. MARSHALL SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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29 OCT 1980

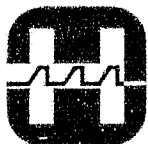
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1.0 SCOPE

This document establishes the baseline for external interfaces of the 10^{13} bit Archival Mass Memory System hereafter referred to as the AMM-13. This document is part of the AMM-13 System Specification.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this ICD to the extent that they provide either a supplementary understanding of the logical concepts of the interface design described herein; are the baseline documents for standard interfaces described herein; or are baseline documents for operator interaction and control. Any conflicts regarding requirements or operations will be resolved by the AMM-13 System Specification.

2.1 Government Documents

Contract NAS8-33687 - Statement of Work
Low Cost Reader - Statement of Work ¹

2.2 MSFC/Harris Documents, Committees, Etc.

AMM-13 System Segment Specification, Reissue 2 dated
29 October 1980
AMM/DBMS Interface Working Group

2.3 Harris Documents

AMM-13 Subsystem Specifications

¹ The Low Cost Reader is included in this ICD for completeness. It is not presently included in the contract scope.

2.4 Vendor Documents

2.4.1 Digital Equipment Corporation (DEC)

QE 001-GS - VAX/VMS Operator and Software Documentation Kit

AA-D025A-TE - Operator's Guide

DEC Peripheral Manuals (As appropriate)

DEC Installation Guide

2.4.2 AMPEX Corporation

PTD Engineering Spec. Sheet

PTD Engineering Spec. 3308829-01

DCP Engineering Spec. 3309527-01

Disk Handler Spec. (TBD)

2.4.3 Replicator

TBD

2.4.4 Film Processor

TBD

2.5 Standards

EIA RS232C Interface between Data Terminal Equipment and Data Communication Equipment employing serial Binary Data Interchange.

2.6 Other Documents

DBMS Configuration Specification, Report 79 HV 013,
October 1979

3.0 INTERFACE CONTROL DOCUMENT (ICD)

3.1 ICD Definition

This documentation defines the various AMM-13 subsystem interconnections to other systems and/or ports within the overall NEEDS operational environment as detailed in the AMM-13 System Specification as required by the procurement Statement of Work (SOW). This document requires approval of the MSFC-Harris IFWG Committee.

3.1.1 Type of Interfaces

3.3.2 Data Transfer Interfaces

3.3.2.1 AMM-13, DBMS, CMS Computer Interconnect

3.3.2.2 AMM-13 Data/Control Input Interface

3.3.2.3 AMM-13 Data/Control Output Interface

3.3.2.4 Test Input Data Source

3.3.3 File Management Interface

4.0 Facilities Interfaces

3.2 Assumptions

The following assumptions are generic to AMM:

1. All data received by the AMM is considered to be error free.
2. The ability of the AMM to sustain a 50 Mbit/sec input rate for two minutes duration is contingent upon all input packets being greater than 16K bits. Interspersed smaller packets will not degrade the AMM input rate provided that: the number of small record frames does not exceed 50,000 in a single two minute burst, a bundle of continuous small records does not exceed 131,072 data bits, and small record bundles are separated by at least 500 milliseconds.

3. The ability of the AMM to sustain a 50 Mbit/sec continuous output rate for the duration of a complete packet is contingent upon a single continuous read of that packet by the S&R. Frame interleaving and multiple reads within the packet may degrade this ability. The burst rate for an individual 2048 bit frame will be maintained in all cases.
4. For each packet received by the AMM, the DBMS will insure that the precise location and format of the packet length field is unambiguous to the AMM.
5. For each packet received by the AMM, the DBMS will insure that the first bit of each primary header occurs at the 2048 bit frame boundary.

3.3 Details

The following paragraphs describe the details of the interfaces for the types of interfaces outlined in paragraph 3.1.1.

3.3.1 Overview

The interfaces described herein represent the complete logical, physical, and functional interconnects to satisfy the Contract Statement of Work, Low Cost Reader Statement of Work, and the requirement for a NEEDS operational integrated test at MSFC.

3.3.1.1 Ground Rules

Ground rules are as follows:

1. A PN Generator may be used as the input test data source for conditional acceptance at the factory.
2. A standard type CRT may be used as the output test device for conditional acceptance at the factory.

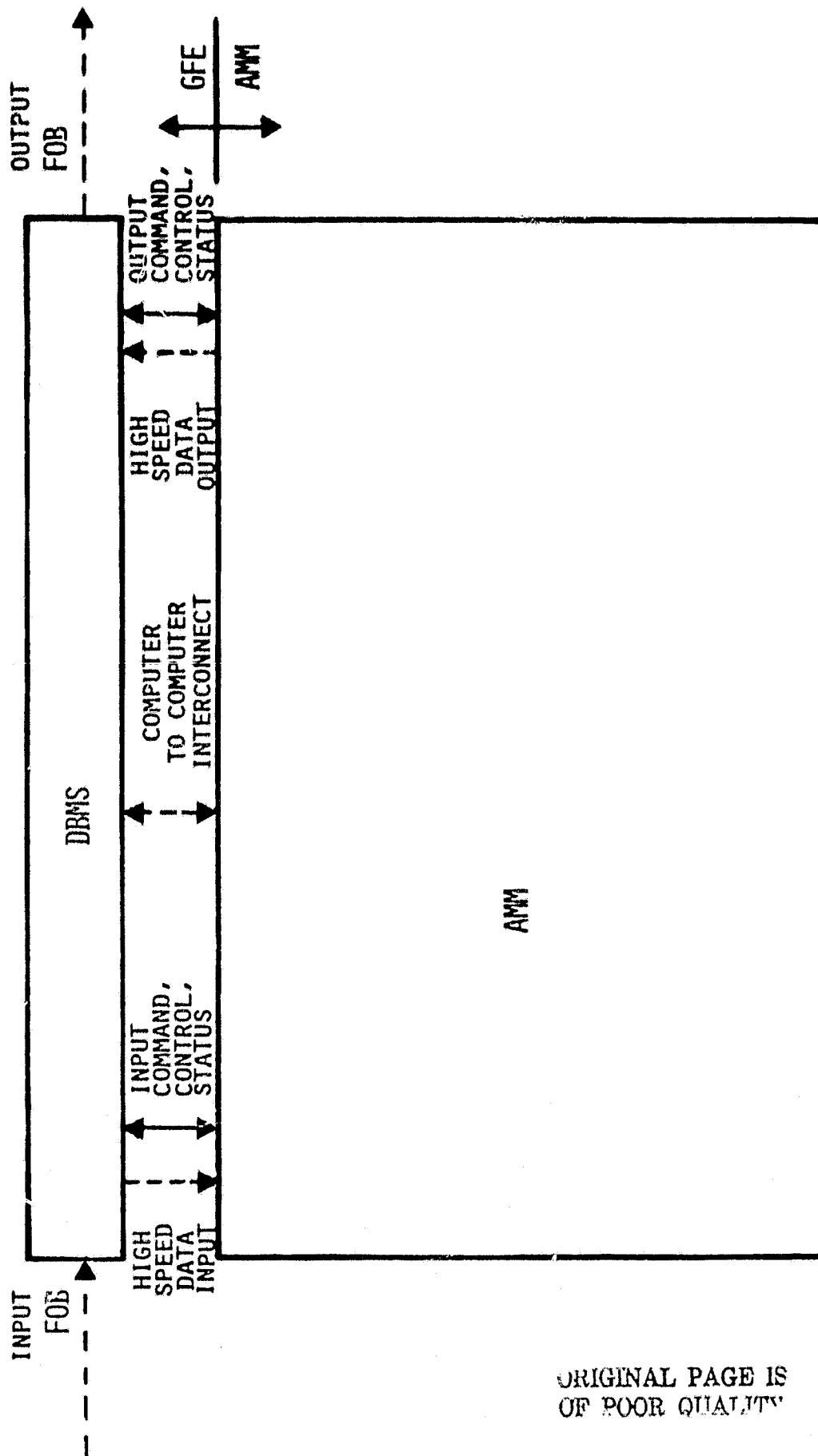


Figure 3.3.2 AMM-13 EXTERNAL INTERFACES

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3. The GFE VAX MA 780-AA multiport memory subsystem (Shared Memory) will provide the AMM-13, DBMS, CMS operational interconnect for assembly and test at MSFC.
4. The SAI input data port from the DBMS will be provided GFE as part of the final NEEDS operational integrated test. FOB generated packets, transmitted to the AMM-13 via the DBMS fiber optic bus, will be the primary high data rate data source for AMM input during the operational test phase.
5. A DBMS FOB port to the USER shall be provided GFE as part of the final NEEDS operational integrated test. S&R output data, transmitted to the USER via the DBMS fiber optic bus, will be the primary high rate data source for AMM output during the operational test phase.

3.3.2 Data Transfer Interfaces

The AMM-13 external data transfer interfaces are shown in Figure 3.3.2 with the following designations:

- A) AMM-13, DBMS, CMS Computer Interconnect
- B) AMM-13 Data/Control Input Interface
- C) AMM-13 Data/Control Output Interface
- D) Test Source Interface

3.3.2.1 AMM/DBMS Computer Interconnect

This interconnect provides the interface between the AMM-13 VAX and the DBMS via a standard VAX-11/780 multiport memory (MA780). The 512K byte MA780 and interconnect cables to the AMM VAX Synchronous Backplane Interconnect shall be GFE. The interconnect diagram is shown in Figure 3.3.2.1. Partitioning of the MA780 shall provide memory address and storage space for:

NOTES:

- (1) See text for functional description
- (2) Refer to VAX 11/780 Hardware Handbook page 113 for line designations
- (3) All cables to connect to the AMM-13 SBI are GFE

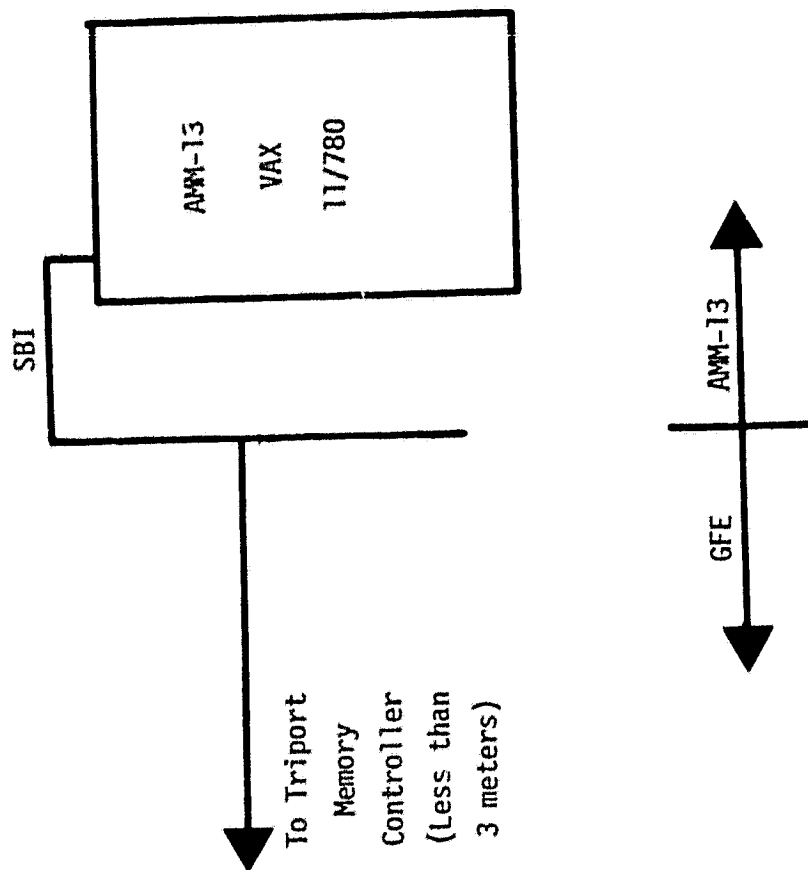


Figure 3.3.2.1 COMPUTER TO COMPUTER INTERCONNECT DIAGRAM

- a. The AMM-13 Status Word shown in Figure 3.3.3.6.b.
- b. The Data Request Queue shown in Figure 3.3.3.6.a.
- c. Temporary buffering of data packets exchanged between the AMM and DBMS VAX computers.
- d. VAX-to-VAX housekeeping in accordance with DEC VMS operating system.

This interface shall handle data requests from the DBMS to the AMM and accommodate low rate, low volume transfers of data between the DBMS and AMM.

3.3.2.2 AMM-13 Data/Control Input Interface

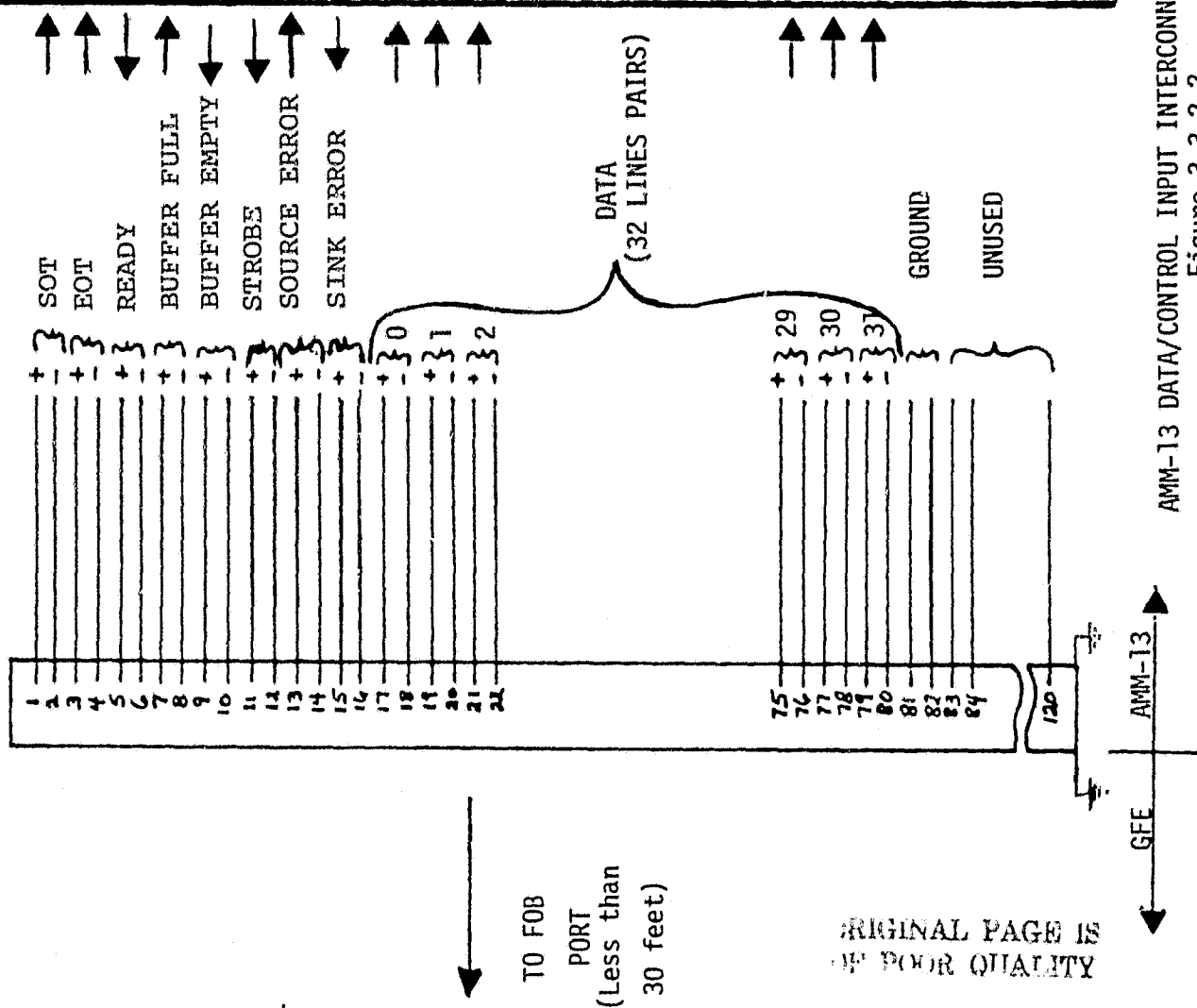
This interface connects the output of the DBMS Data Bus Port Adapter to the AMM-13 Input Subsystem. It shall provide the means by which the AMM controls the high speed input data stream. Data shall be transferred over 32 parallel lines by strobing these lines 64 times per frame at a 1.6 MHz rate. This shall provide a burst rate of 51.2 Mbits/sec for a 2048 bit frame. Control signals exchanged shall be such that a 50 Mbit/sec average rate is maintained. The AMM-13 Data/Control Input Interconnect Diagram is shown in Figure 3.3.2.2. All signals are TTL compatible logic levels as seen by the inputs to the line drivers and outputs of the line receivers. Signals sourced by the DBMS shall change state on the rising edge of STROBE and signals sourced by the AMM shall change state on the falling edge of STROBE (except ERROR).

SOT - DBMS shall raise SOT at the start of each new packet and lower SOT when the AMM strobes the first 32 bits of the packet from the port. SOT is used to signify a start of transmission from a cold start as well as marking the first frame of each packet.

EOT - DBMS shall raise EOT whenever the ingest cycle is expected to be interrupted for more than 20 seconds, and shall be lowered by the DBMS when the AMM drops READY. EOT is used

NOTES:

- (1) See text for functional description
- (2) Connector: Elco Series 8016 female 120 contact plug with recessed contacts
- (3) Line transmitters: Advanced Micro Devices - Differential AM 26LS31
- (4) Line receivers: Advanced Micro Devices - Differential terminated with 100Ω resistor AM 26LS32
- (5) Male connector and interconnect cable are GFE National Wire and Cable Corporation D-200 Series - Low Voltage Digital Computer Cable



AMM-13 DATA/CONTROL INPUT INTERCONNECT DIAGRAM
Figure 3.3.2.2

to signify that the AMM may revert to a cold-start readiness condition for high speed data ingest.

READY - AMM shall under normal conditions raise READY within 20 milliseconds of receipt of SOT. READY shall not change state during the strobe of a 2048 bit frame of data. The AMM shall lower READY in response to EOT, during the solid state memory refresh cycle (refresh time of 75 microseconds is required if one millisecond has elapsed between frame transfers), whenever the AMM cannot accept data (e.g. at the expiration of the 2 minute 50 Mbit/sec burst), or if an ERROR condition exists.

BUFFER FULL - The DBMS shall raise BUFFER FULL when a 2048 bit frame of data is loaded and ready for the AMM to accept. If READY has been raised, the AMM shall strobe DATA 64 consecutive times starting with the first falling edge of STROBE immediately following the raising of BUFFER FULL. DBMS shall lower BUFFER FULL on the first rising edge of STROBE immediately following assertion of BUFFER EMPTY.

BUFFER EMPTY - The AMM shall raise BUFFER EMPTY on the falling edge of the 64th STROBE following assertion of BUFFER FULL. AMM lowers BUFFER EMPTY on the first falling edge of STROBE immediately following assertion of BUFFER FULL. BUFFER EMPTY remains high at all times except when data is actually being transferred over the DATA lines.

STROBE - This is the 1.6 MHz symmetric clock pulses provided by the AMM to synchronize the port protocol and data transfer. STROBE shall be active under all normal operating conditions.

SOURCE ERROR - This signal shall be lowered by the DBMS to signify

an error condition which warrants the stopping of data flow. It is an asynchronous signal which may be lowered at any time. Under normal conditions the DBMS shall hold SOURCE ERROR high.

SINK ERROR - This signal shall be lowered by the AMM to signify an error condition which warrants the stopping of data flow. It is an asynchronous signal which may be lowered at any time. Under normal conditions the AMM shall hold SINK ERROR high.

DATA (0-31) - Transfer of data packets from the DBMS to the AMM shall be over the DATA lines. The DBMS shall present 32 bit data words to these lines on the rising edge of STROBE and the AMM shall accept the 32 bit data words on the falling edge of STROBE. DATA shall be strobed 64 consecutive times for each 2048 bit frame transfer. A data line which is high represents a logical binary "one".

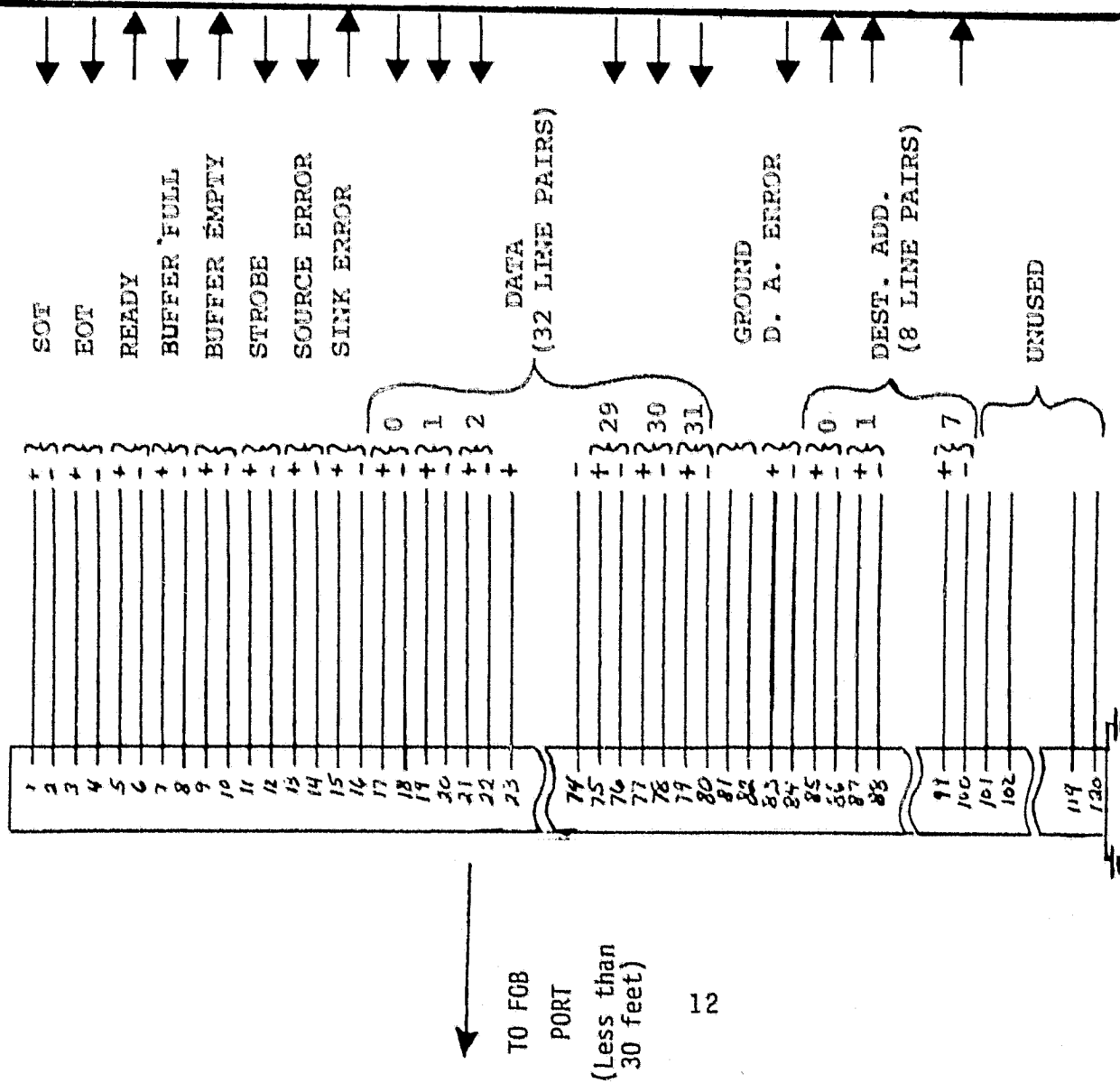
GROUND - This line shall provide a ground reference for all logic signals. In addition, the cable shield shall be attached to the chassis at either end for chassis ground.

3.3.2.3 AMM-13 Data/Control Output Interface

This interface connects the output of the AMM-13 Output Subsystem to the DBMS Data Bus Port Adapter. It shall provide the means by which the AMM controls the high speed output data stream. Data shall be transferred over 32 parallel lines by strobing these lines 64 times per frame at a 1.6 MHz rate. This shall provide a burst rate of 51.2 Mbits/sec for a 2048 bit frame. Control signals exchanged shall be such that a 50 Mbit/sec average rate is maintained. The AMM-13 Data/Control Output Interconnect Diagram is shown in Figure 3.3.2.3. All signals are TTL compatible logic levels as seen by the inputs to the line

NOTES:

- (1) See text for functional description
- (2) Connector: Elco Series 8016 female 120 contact plug with recessed contacts
- (3) Line transmitters: Advanced Micro Devices - Differential AM 26LS31
- (4) Line receivers: Advanced Micro Devices - Differential terminated with 100Ω resistor AM 26LS32
- (5) Male connector and interconnect cable are GFE.
National Wire and Cable Corporation
D-200 Series - Low Voltage Digital Computer Cable



AWM-13 DATA/CONTROL OUTPUT INTERCONNECT DIA6.34M
Figure 3.3.2.3

drivers and the outputs of the line receivers. Signals sourced by the DBMS shall change state on the rising edge of STROBE and signals sourced by the AMM shall change state on the falling edge of STROBE (except ERROR).

SOT - AMM shall raise SOT at the start of the first frame of a request for a particular destination address, and shall lower SOT when the AMM strobes the first 32 bits of the request into the port.

EOT - AMM shall raise EOT at the start of the last frame of a request for a particular destination address, and shall lower EOT when the AMM strobes the first 32 bits of the last frame of the request into the port.

READY - DBMS shall raise READY as soon as the port is able to accept data bound for the destination address presented to the AMM by DEST. ADD. The AMM shall not interrupt data transfer if the DBMS lowers READY during the 64 strobes of data within a 2048 bit frame. READY shall remain high for subsequent sequential frames of a particular request bound for the same destination address. The AMM shall not respond to signals present on DEST. ADD. unless READY is high.

BUFFER FULL - The AMM shall raise BUFFER FULL on the falling edge of the 64th STROBE following assertion of BUFFER EMPTY.

The AMM shall lower BUFFER FULL on the first falling edge of STROBE immediately following assertion of BUFFER EMPTY. BUFFER FULL remains high at all times except when data is actually being transferred over the DATA lines.

BUFFER EMPTY - The DBMS shall raise BUFFER EMPTY when it can accept a 2048 bit frame of data. If READY has been raised, the AMM shall strobe DATA 64 consecutive times starting with

the first falling edge of STROBE immediately following the raising of BUFFER EMPTY. DBMS shall lower BUFFER EMPTY on the first rising edge of strobe immediately following assertion of BUFFER FULL.

STROBE - This is the 1.6 MHz symmetric clock pulses provided by the AMM to synchronize the port protocol and data transfer.

STROBE shall be active under all normal operating conditions.

SOURCE ERROR - This signal shall be lowered by the AMM to signify an error condition which warrants the stopping of data flow. It is an asynchronous signal which may be lowered at any time. Under normal conditions the AMM shall hold SOURCE ERROR high.

SINK ERROR - This signal shall be lowered by the DBMS to signify an error condition which warrants the stopping of data flow. It is an asynchronous signal which may be lowered at any time. Under normal conditions the DBMS shall hold SINK ERROR high.

DATA (0-31) - Transfer of requested data from the AMM to the DBMS shall be over the DATA lines. The AMM shall present 32 bit data words to these lines on the rising edge of STROBE and the DBMS shall accept 32 bit data words on the falling edge of STROBE. DATA shall be strobed 64 consecutive times for each 2048 bit frame transfer. A data line which is high represents a logical binary "one".

GROUND - This line shall provide a ground reference for all logic signals. In addition, the cable shield shall be attached to the chassis at either end for chassis ground.

D.A. ERROR - This shall be a logic level which is raised by the AMM to indicate that the AMM does not have data staged for the request destination address presently in DEST. ADD.

D.A. ERROR shall be lowered by the AMM upon changing of the entry in DEST. ADD.

DEST. ADD. (0-7) - These eight lines shall be set by the DBMS to point to the next frame of data to be output by the AMM. The AMM shall have requests staged by destination address and shall select the next sequential frame of the request pointed to by DEST. ADD. as the next frame to be output over the DATA lines. When no data output is required, DBMS shall set DEST.ADD. to all zeroes.

3.3.2.4 Test Source Interface

The test source shall interface directly to the AMM-13 Data/Control Input Interface described in Section 3.3.2.2.

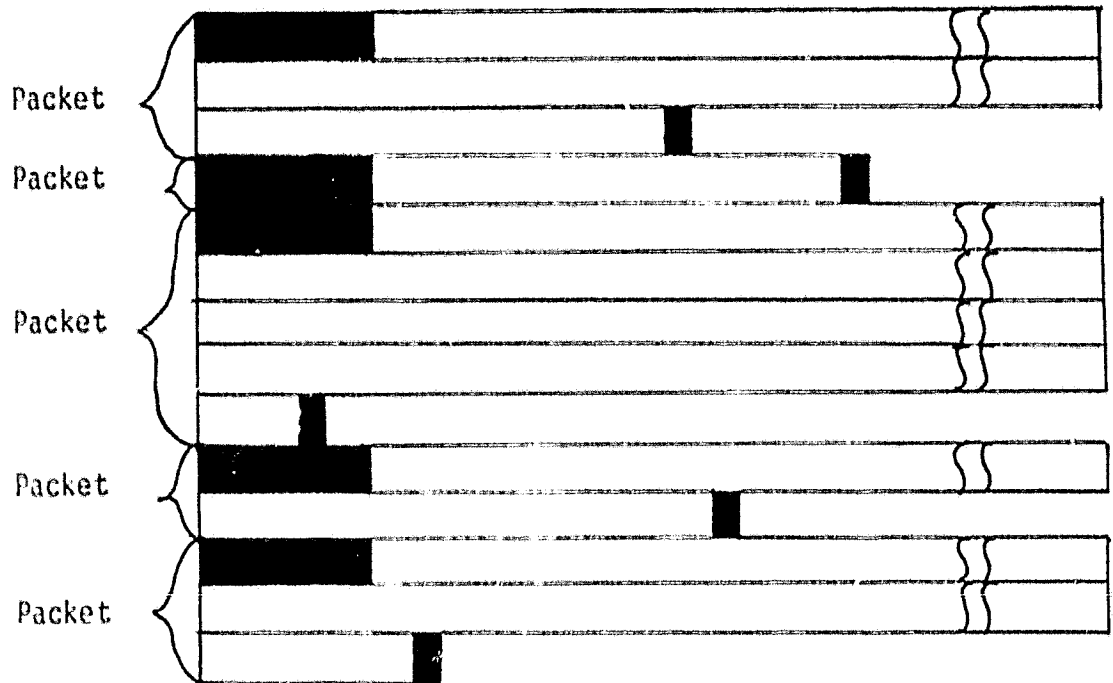
3.3.2.5 Input Data Description

The AMM has two paths by which it receives data to be stored in the archival mass memory. The principal data path is via a high speed FOB port and the secondary path is via the triport memory. High speed data ingest via the FOB port has top input priority within the AMM and no other operations will be performed which interfere with the high speed data ingest process.

3.3.2.5.1 High Speed (FOB Port) Input Data Format

All input data is organized such that the only recognizable unit is a packet. Each packet contains a header, data, and packet parity. The header consists of a 64 bit primary header and a secondary header of at least 64 bits. Since the AMM is not concerned with secondary header information subsequent to the first 64 bits, all subsequent bits of the secondary header are treated as data bits. Thus, the AMM is concerned with the first 128 bits of a packet for header information. Likewise, since the AMM performs no error or parity checking on

INPUT DATA FORMAT



← 2048 bits →

← PACKET HEADER 128 bits

← PACKET PARITY 16 bits

Figure 3.3.2.5.1.a

input, the 16 bit packet parity is also considered to be data bits. Packets are sent to the port buffer as an integer number, N, of 2048 bit frames ($N = 2, 2, \dots, 1984$). A frame shall not contain information from more than one packet. Each new packet shall start on a frame boundary. A frame which contains a packet whose length is less than 256 bytes or a frame which is the last frame of a packet and contains less than 256 bytes, shall not be filled with other packet information. The AMM shall disregard all bits in the 2048 bit buffer which are determined to be in excess of the packet length. This concept is depicted in Figures 3.3.3.3.1.a. and 3.3.3.3.1.b.

Packet lengths are measured in terms of the number of bits contained in a packet. The packet length includes all bits in the primary header, secondary header, data bits, and packet parity bits. The number of bits in a packet is always an integer multiple of 8 bit bytes. Packet lengths are given by either the PL field or the PLI field as follows:

In the PL field, the first four bits represent the exponent (E) and the last four bits represent the mantissa (M) by which the packet length (L) is calculated from the formula below.

$$L = (128 + 8M) \times 2^E \quad \text{where}$$

$$M = 0, 1, 2, \dots, 15$$

$$E = 1, 2, 3, \dots, 14$$

With this representation, there are 224 valid packet lengths from 256 bits to 4063232 bits. If the PL field contains all zeroes, the packet length is determined by the PLI field.

The PLI field contains an integer number, N, which signifies the packet length, L, as an absolute number of bits calculated from the formula below.

$$L = N \quad \text{where}$$

$$N = 256, 264, 272, \dots, 16777216$$

HEADER CONTENTS

128 bits (16 bytes)

SID 8	MID 8	SSC 16	PL 8	SP 8	SHID 8	SIDP 8	TF 8	TIME 32	PLI 24	DATA
----------	----------	-----------	---------	---------	-----------	-----------	---------	------------	-----------	------

- SID - SOURCE IDENTIFICATION
- MID - MISSION IDENTIFICATION
- SSC - SOURCE SEQUENCE COUNT
- PL - PACKET LENGTH
- SP - SPARE
- SHID - SECONDARY HEADER IDENTIFICATION
- SIDP - SOURCE IDENTIFICATION PARITY
- TF - TIME FORMAT
- TIME - TIME
- PLI - PACKET LENGTH INTEGER

Figure 3.3.2.5.1.5

With this representation there are 2097121 valid packet lengths.

3.3.2.5.2 High Speed (FOB Port) Input Data Transfer

The 2048 bit frame buffer is loaded sequentially from bit location 0 to 2047. The first 128 bits of the first frame of a packet (header bits) are loaded into bit locations 0 to 127 in the frame buffer. In the event that the entire 2048 bit buffer is not fully loaded (i.e., packet length is less than one frame length, or last frame of a packet is less than one frame length), the filled bit locations are sequential from bit location 0 to the bit location containing the last bit of the packet. Upon completion of data transfer into the frame buffer, the CMS loads the 32 bit AMM input buffer with bits 0 - 31. The AMM clocks out the data in the buffer and the CMS loads bits 32 - 63, etc. Assuming that all handshakes are satisfactory, the AMM strobes data out of the 32 bit buffer every clock pulse (625 nanoseconds) for a 51.2 Mbit/sec transfer rate.

The maximum number of frames which must be accepted by the AMM in one two-minute burst, is 2929688 frames. If every frame contains 2048 bits of packet data, this corresponds to 6000001024 bits of packet data received by the AMM in two minutes or just over a 50 Mbits/sec average rate during the two-minute burst.

3.3.2.5.3 Low Speed (Triport) Input Data Format

The low speed data format is the same as the high speed data format described in Section 3.3.3.3.1 with the following modifications. The PL field will always be all zeroes and the packet length information is contained in the PLI field. Packets are transferred via the triport as an integer number of 32 bit words. A word shall not contain information from more than one packet. Each new packet shall start on a word boundary.

3.3.2.5.4 Low Speed (Triport) Input Data Transfer

This transfer is controlled by the AMM VAX 11/780 using the standard logical concepts specified by the computer manufacturer (DEC). This transfer shall not interrupt or interfere with high speed data ingest from the FOB port.

3.3.2.6 Output Data Description

The AMM has two paths by which it outputs data from the archival mass memory. The principal data path is via a high speed FOB port and the secondary path is via the triport memory. High speed data output via the FOB port has top output priority within the AMM and no other operations will be performed which interfere with the high speed data output process.

3.3.2.6.1 High Speed (FOB Port) Output Data Format

Output data consists of a sequential string of data bytes in accordance with the data request. The 32 bit output buffer shall not contain information from more than one packet unless the request was for multiple packets. Multiple packet requests shall result in loading of the buffer without regard to packet headers (except the first header) until the total byte count is exhausted.

Output request data byte strings which are less than 32 bits (or are not an integer multiple of 32 bits) shall result in partial filling of the 32 bit FOB output buffer. The CMS shall exercise control of the readout of the FOB buffer to avoid clocking out the unfilled bits.

3.3.2.6.2 High Speed (FOB Port) Output Data Transfer

The 2048 bit frame buffer is loaded sequentially by the CMA from bit location 0 to 2047 in 32 bit word increments. In the event that the entire 2048 bit buffer is not fully loaded (i.e., requested data is less than one

frame length, or the last frame of a request is less than one frame length) the filled bit locations are sequential from bit location 0 to the bit location containing the last bit of the request. The remaining bit locations shall be arbitrarily filled. The frame buffer is considered to be "full" after 64 data strobe clock pulses. Assuming that all handshakes are satisfactory, the AMM loads the 32 bit output buffer every clock pulse (625 nanoseconds) for a 51.2 Mbit/sec transfer rate.

The AMM shall stage small output requests to allow interleaving of output frames as directed by the CMS. (See Sections 3.3.3.6 and 3.3.5.2 for description of queues and scanario). Frame interleaving to accommodate slow user data rates shall negate the AMM average data output rate requirement of 50 Mbits/sec. The high end of the "up to 50 Mbits/sec" data output rate requirement shall only be maintained when requested data is contiguous on one fiche and frame interleaving is not being performed. Once a word has been loaded into the AMM output buffer, the CMS assumes responsibility for transfer to the user.

3.3.2.6.3 Low Speed (Triport) Output Data Format

Output data consists of a sequential string of data bytes in accordance with the data request. Requested data is transferred as 32 bit words in accordance with the VAX 11/780 operation.

3.3.2.6.4 Low Speed (Triport) Output Data Transfer

This transfer is controlled by the AMM VAX 11/780 using the standard logical concepts specified by the computer manufacturer (DEC). This transfer shall not interrupt or interfere with the high speed data output to the FOB port. Once the requested data has been loaded into the Triport, the CMS assumes responsibility for subsequent transfer to the user.

3.3.3 AMM-13 File Management Interface

3.3.3.1 Introduction

The file management configuration discussed herein describes the objectives and data flow of the input and output. This configuration accommodates the Factory Test, and the Interface.

3.3.3.2 Concept

The AMM file manager uses an ID table directory scheme to identify location within a predetermined fiche element (to be called a SEGMENT) consistent with the AMM record and read capabilities. The table directory file organization and access shall be (TBD) and shall be created by RMS-11. On Input, the ID is retrieved from the data stream and used to build the table directory.

On output, the AMM shall locate the requested information and will, in accordance with the STARTING LOCATION IN PACKET (SL) and TOTAL TRANSFER (TT) fields, provide the requested output data. In the event that a low speed device (less than 50 Mbits/sec) connected to the DBMS FOB requests a data string whose length exceeds the S&R output buffer capacity (approximately 2 Mbits), the AMM shall initiate multiple sequential reads within the fiche to accommodate the reduced output rate.

3.3.3.3 Assumptions

The following assumptions are generic to AMM:

1. Each packet received by the AMM has a unique identification specified in the packet header (see Figure 3.3.2.5.1.b).

In the event that multiple transmissions of the same packet are received by the AMM, the most recently received packet will be the only one maintained by the AMM file manger.

2. All data packets received by the AMM shall be sequential within any particular SID.
3. All X.25 protocol, DBMS headers, and CRC shall be removed prior to transmission to the AMM.

3.3.3.4 File Organization

The AMM file organization is structured to assure access to any packet of data stored in the AMM system. Packet data may be stored in: (1) off-line fiche packs, (2) on-line fiche packs housed in S&R units, or (3) magnetic disks (RM05 and/or AMPEX). In any case, a table directory is established by the AMM which maps each packet into a specific storage location. The packet shall be represented by a 64 bit identification as shown below:

DATA	SID	MID	SSC	TIME
BITS	8	8	16	32

The location within the AMM shall be represented by a 64 bit address.

3.3.3.5 Data Request Format

Data requests sent from the DBMS to the AMM shall be in the format below

DATA REQUEST FORMAT								
DATA	FL	S I D	M I D	SSC	TIME	SL	TT	DA
BITS	16	8	8	16	32	32	32	16

Figure 3.3.3.5.a

FL	-	STATUS FLAG
SID	-	SOURCE ID
MID	-	MISSION ID
SSC	-	SOURCE SEQUENCE COUNT
TIME	-	TIME AS PER SECONDARY HEADER
SL	-	STARTING LOCATION IN PACKET (BYTE NUMBER)
TT	-	TOTAL TRANSFER (BYTES)
DA	-	DESTINATION ADDRESS

The SID, MID, SSC, and TIME are as previously defined.

FL - STATUS FLAG

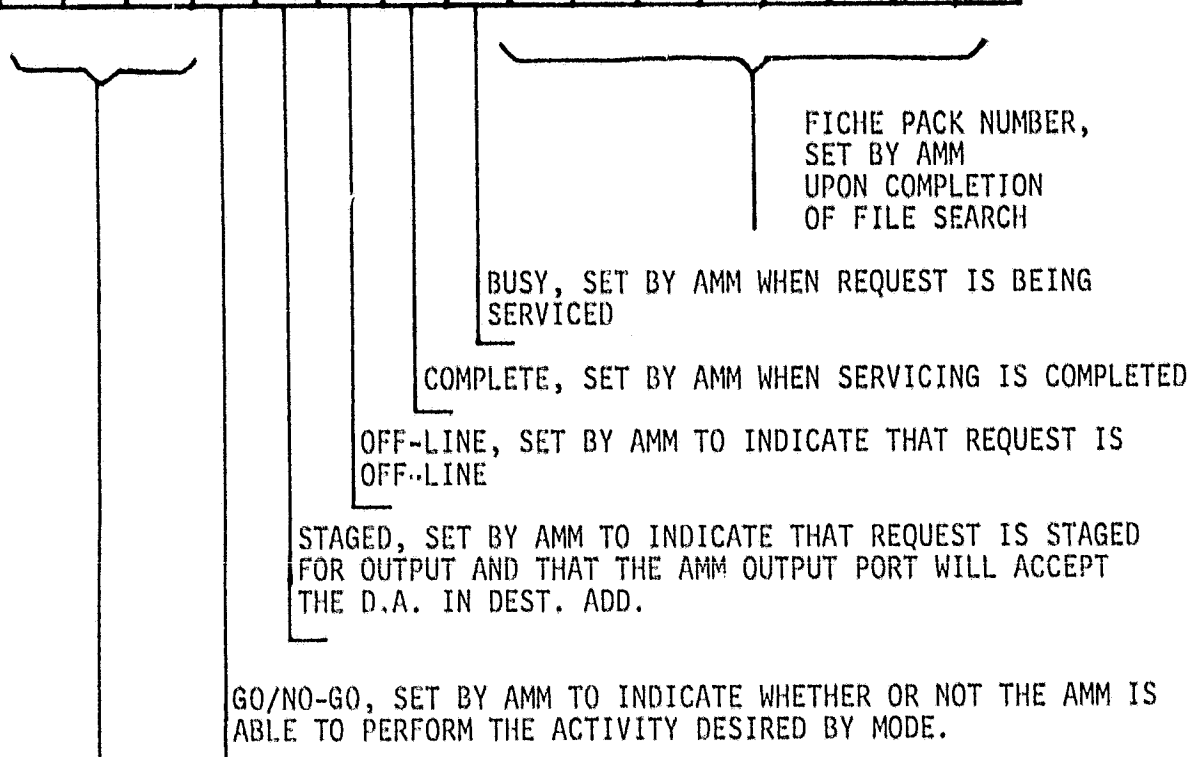
The FL field shall provide the means by which the DBMS and the AMM exchange command and control information concerning individual data requests. This field is defined in Figure 3.3.3.5.b.

SL - STARTING LOCATION

This field contains an integer number indicating the first 8 bit byte of data to be output. For example: if the entire packet including the header is requested, the SL field shall contain the integer "one". Subsequent starting locations within the packet are indicated by subsequent integer numbers of 8 bit bytes. If SL contains all zeroes, the AMM output shall start with the first byte of the header of the packet identified in the data request and continue until the TT field is exhausted irrespective of subsequent packet boundaries. In this case the output data shall be whatever is sequentially recorded on the fiche after the first byte. No requirement is placed on the AMM as to the identity of any packets except the first.

FL - STATUS FLAG

MODE			STATUS					LOCATION							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



ALL MODES SET BY DBMS TO INDICATE ACTIVITY.

000	INVALID
001	FILE SEARCH
010	READ/OUTPUT DATA
011	DELETE FROM DIRECTORY
100	} UNASSIGNED
101	
110	
111	ABORT

FL - STATUS FLAG

FIGURE 3.3.3.5.b

TT - TOTAL TRANSFER

This field contains an integer number indicating the total number of 8 bit bytes to be output. This number includes the first byte flagged by SL. If TT is all zeroes, the request is for the entire packet and the AMM shall respond accordingly.

DA - DESTINATION ADDRESS

The first 8 bits shall contain the port address or the shared memory buffer address. The AMM shall use this to distinguish between requests that are to be sent via the FOB port or sent via the triport shared memory.

For those requests to be sent via the FOB port, the AMM shall copy the last 8 bits of DA which represent the user terminal and shall utilize the address to stage requests in the AMM Output Subsystem.

3.3.3.6 Data Request Queue

This queue shall be established in the Triport to facilitate the servicing of data requests by the AMM as a peripheral device to the DBMS. The general operation of queue consists of the DBMS loading data request entries with appropriate commands inserted in the flag field and the AMM inserting request servicing status in the flag field. The Data Request Queue is shown in Figure 3.3.3.6.a with the AMM Status Word and Data Request Format as defined in Figure 3.3.3.6.b and Paragraph 3.3.3.5 respectively. The DBMS Command Word Structure is shown in Figure 3.3.3.6.c.

AMM STATUS WORD	
DBMS COMMAND WORD	
SET NUMBER 1	COUNT/STATUS
SET NUMBER 2	COUNT/STATUS
SET NUMBER 3	COUNT/STATUS
FIRST REQUEST IN SET NUMBER 1 ⋮ 10 WORDS (16 BITS/WORD)	
SECOND REQUEST IN SET NUMBER 1 ⋮	
LAST REQUEST IN SET NUMBER 1 ⋮	
FIRST REQUEST IN SET NUMBER 2 ⋮	
LAST REQUEST IN SET NUMBER 2 ⋮	
FIRST REQUEST IN SET NUMBER 3 ⋮	
LAST REQUEST IN SET NUMBER 3 ⋮	

DATA REQUEST QUEUE

Figure 3.3.3.6.a

AMM-13 STATUS WORD (TRIPOD)

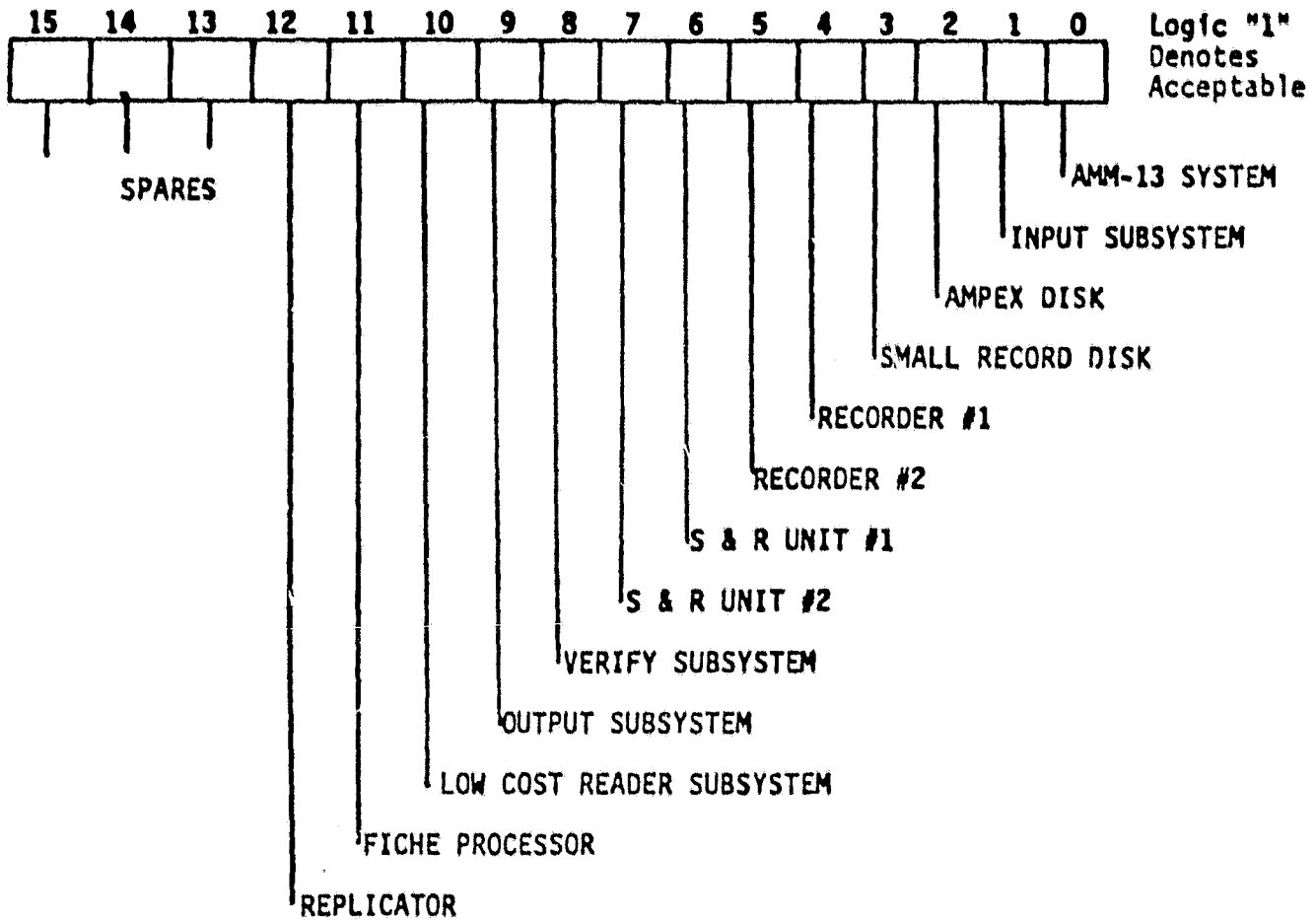


FIGURE 3.3.3.6.b

DBMS COMMAND WORD

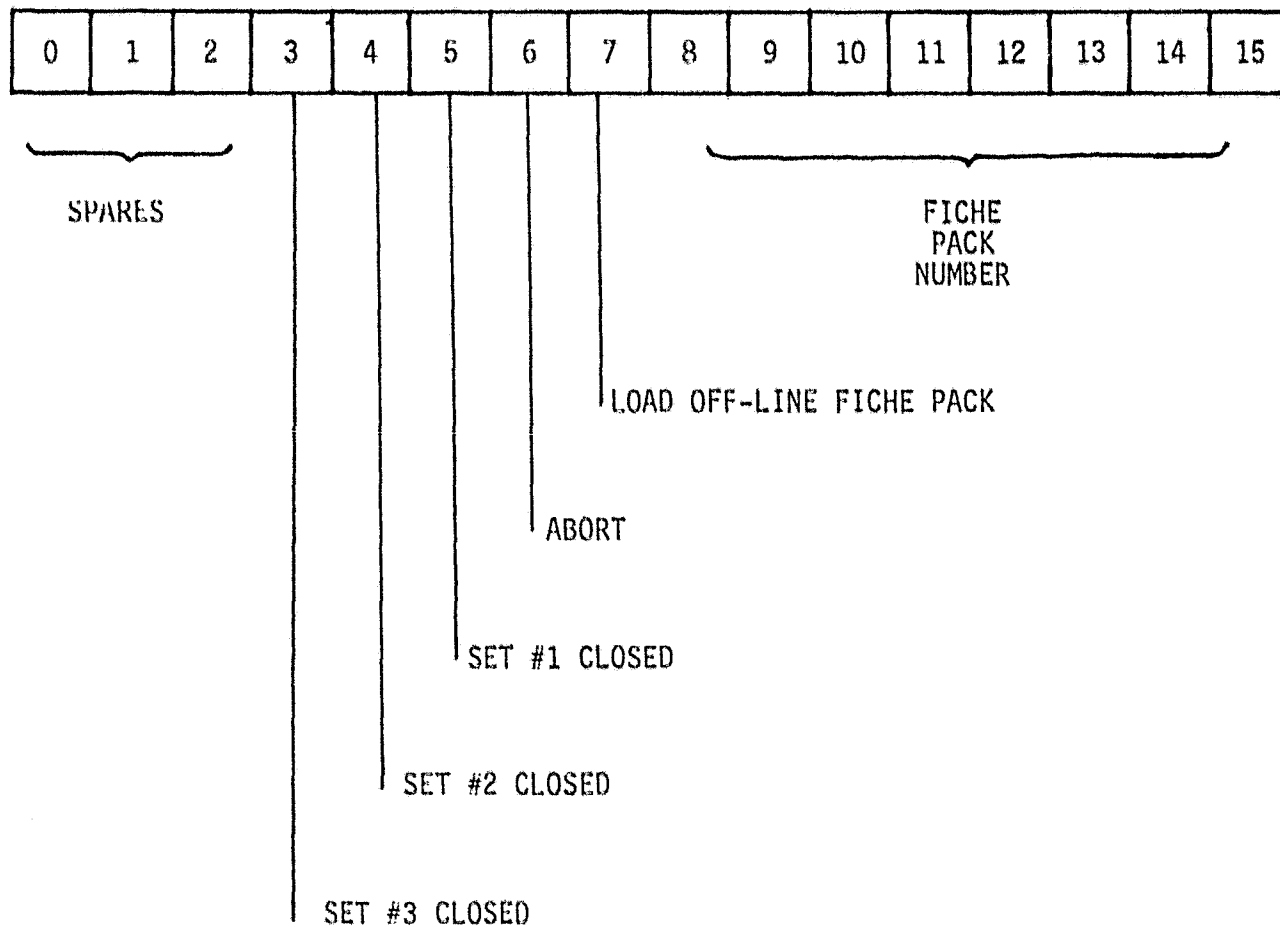
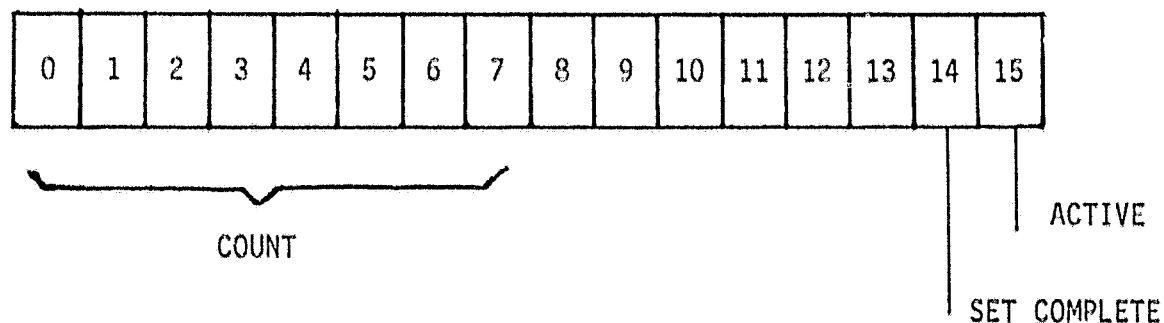


Figure 3.3.3.6.c

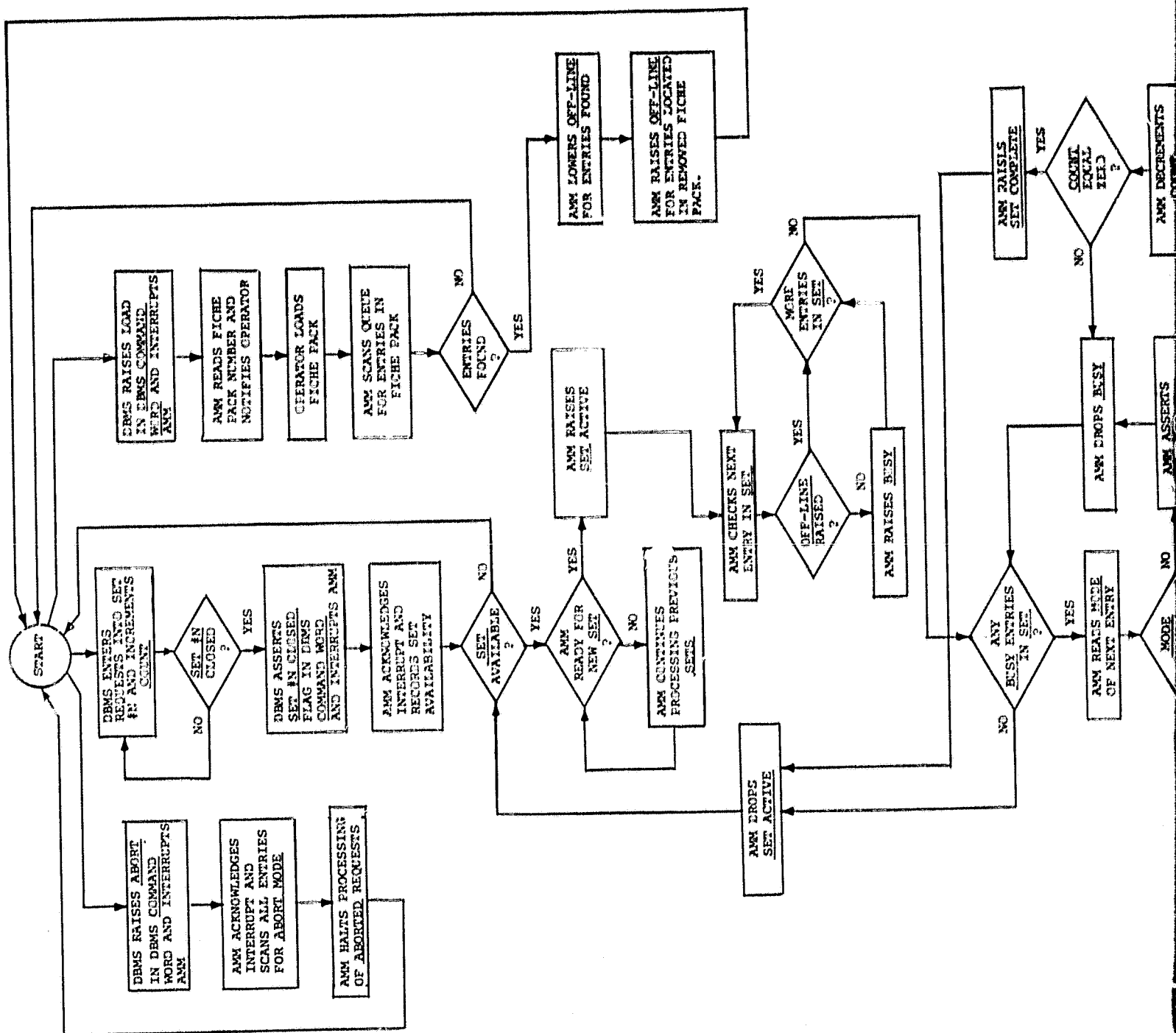
The DBMS uses the DBMS Command Word to notify the AMM that sets of data requests are closed so that the AMM can optimize retrieval within the set. The DBMS sets the ABORT flag to notify the AMM via interrupt that it has aborted one or more requests in the queue. The AMM shall then examine the MODE portion of each request to determine which entries have been aborted. The DBMS monitors the FLAG field of the Data Request Queue to determine which requests are located in particular off-line fiche packs. Based upon this information and other information known to the DBMS (such as priority) the DBMS may command the AMM to load a particular fiche pack by entering the fiche pack number and raising bit 7 of the DBMS Command Word. The AMM operator shall then load the appropriate fiche pack and the AMM shall service all entries in the entire queue which are resident in that fiche pack.

SET NUMBER - COUNT/STATUS WORD



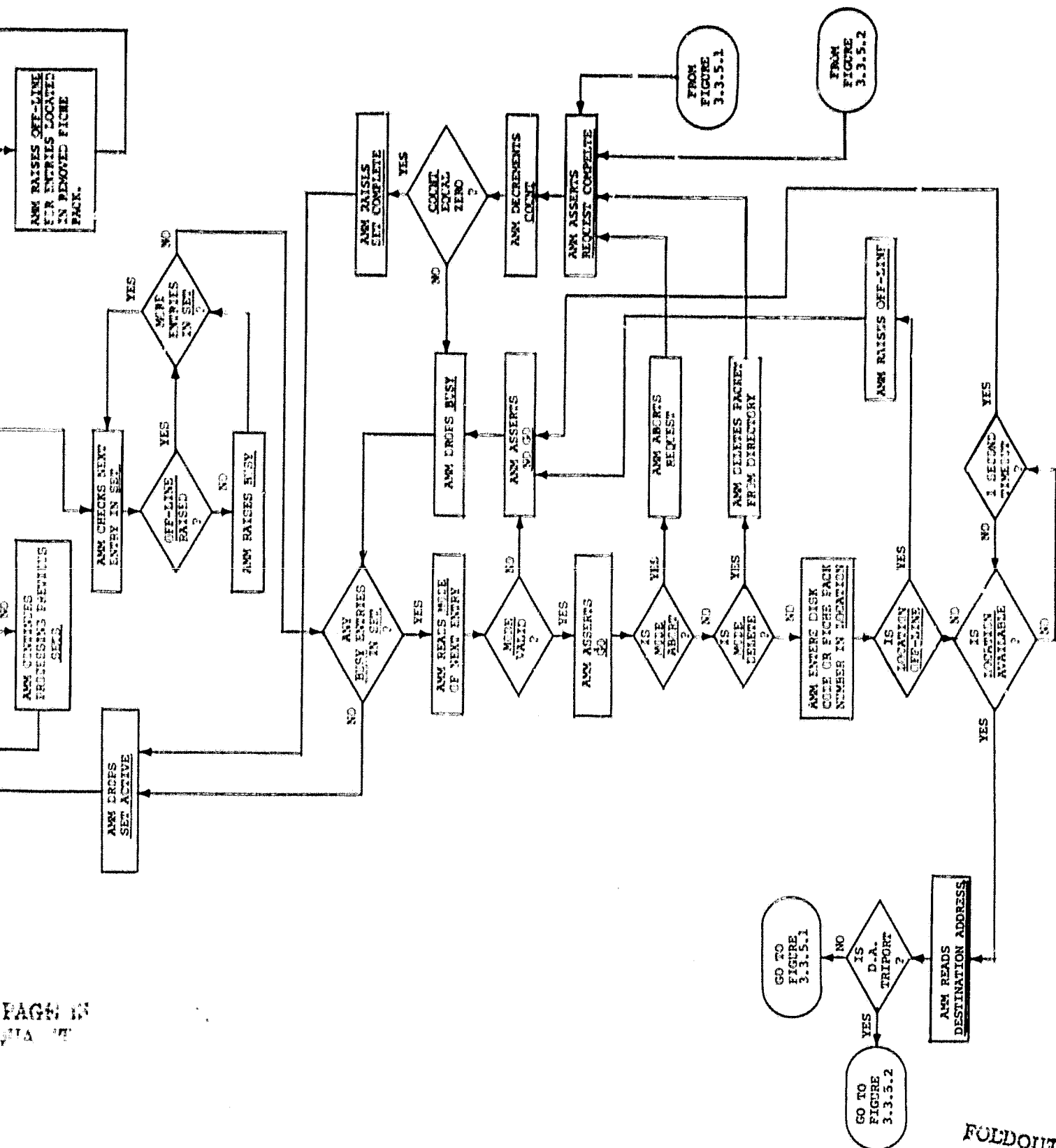
The SET COUNT/STATUS word shall be as shown above. COUNT represents the number of entries in the set with bit 7 being the least significant bit. COUNT is presently limited to eight entries with expansion capability provided and is set by DBMS. COUNT is decremented by AMM upon satisfactory completion of each data request. (See discussion of FLAG field for interpretation of the meaning of satisfactory completion of a data request.) COUNT is not decremented by the AMM if the requested data is off-line. Thus, if the AMM lowers SET ACTIVE and COUNT is non-zero, then COUNT represents the number of off-line

requests in that set. DBMS may enter new requests into the addresses which were serviced, (in which case the AMM shall ignore those already marked as off-line) or command the AMM to load the appropriate off-line fiche pack. Once a set has been closed by the DBMS by appropriate entry in the DBMS Command Word, the AMM shall raise ACTIVE (bit 15) of the SET COUNT/STATUS Word to indicate that that set is being optimized and/or processed by the AMM. Upon completion of processing, the AMM shall lower ACTIVE and raise SET COMPLETE. The process is depicted in Figure 3.3.3.6.d.



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FOLDOUT FRAME



REQUEST PROCESS FLOWCHART
FIGURE 3.3.3.6.d.

FOLDOUT FRAMES 2

3.3.4 Input Scenario

The AMM receives input data from the input high speed FOB port and the low speed triport. All received data is to be stored in the archival mass memory. In order to provide immediate access to all records and in order to assure a logical data flow through the system, all input data is prestaged on magnetic disks. Small records (256 to 16384 bits) received either via the FOB port or the triport, are routed directly to an RM05 disk for temporary storage and staging. Large records (greater than 16384 bits) received via the FOB port are routed directly to the AMPEX disk for temporary storage and staging. Forward file management is provided for large records as the input is received. File management for small records is provided at computer compatible rates in conjunction with staging on the RM05. The Recorder Subsystem receives all data for archiving directly from the AMPEX disk. All input data is retained on disks until recorded fiche are available for access and servicing of output requests. This insures that user requests are not delayed by the AMM processing function.

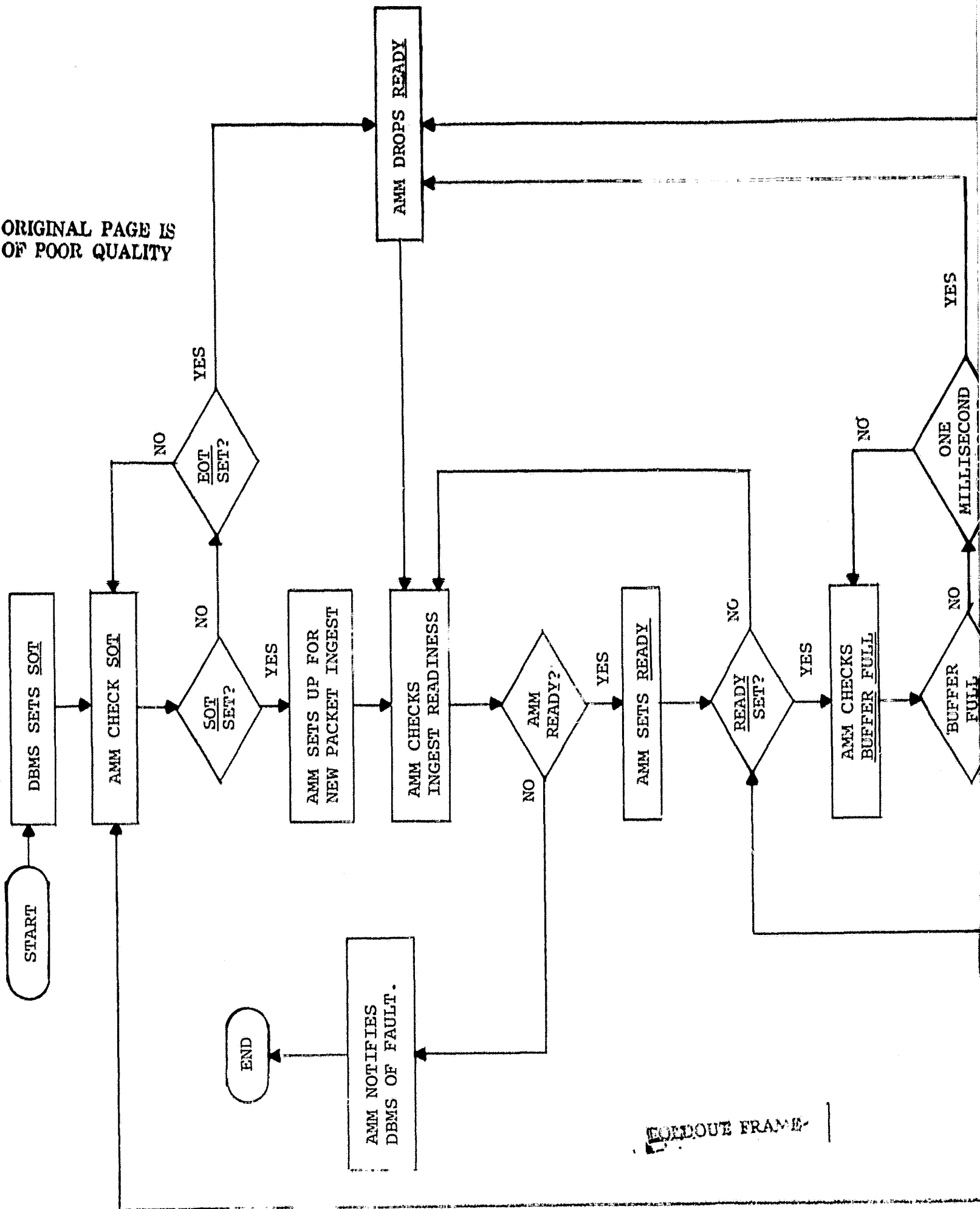
3.3.4.1 Input via FOB

Input data format and transfer are discussed in Sections 3.3.2.5.1 and 3.3.2.5.2 respectively. Figure 3.3.4.1 depicts the process.

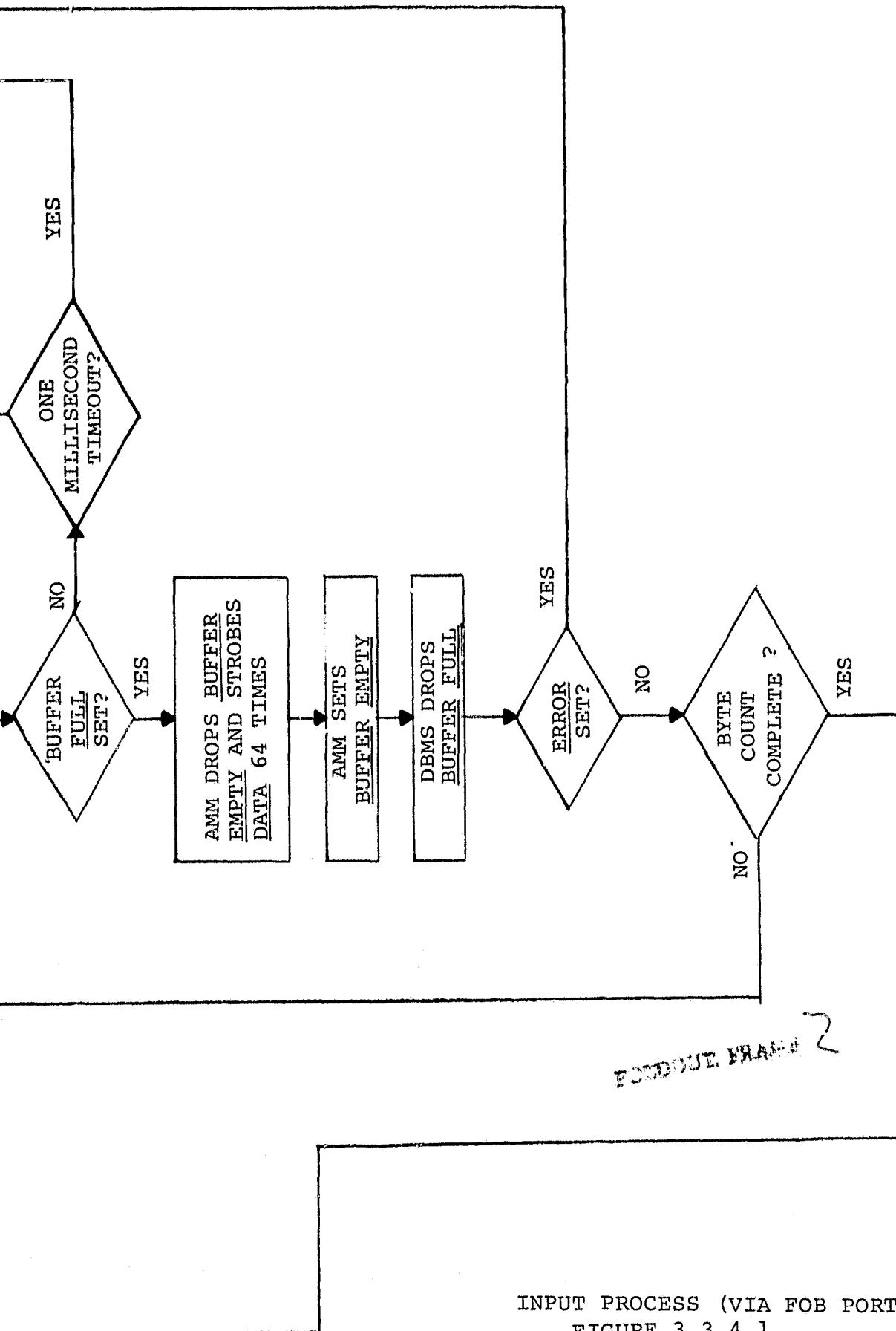
3.3.4.2 Input via Triport

Input data format and transfer are discussed in Sections 3.3.2.5.3 and 3.3.2.5.4 respectively. Figure 3.3.4.2 depicts the process.

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ENCLOSURE FRAME-



INPUT PROCESS (VIA FOB PORT)
FIGURE 3.3.4.1

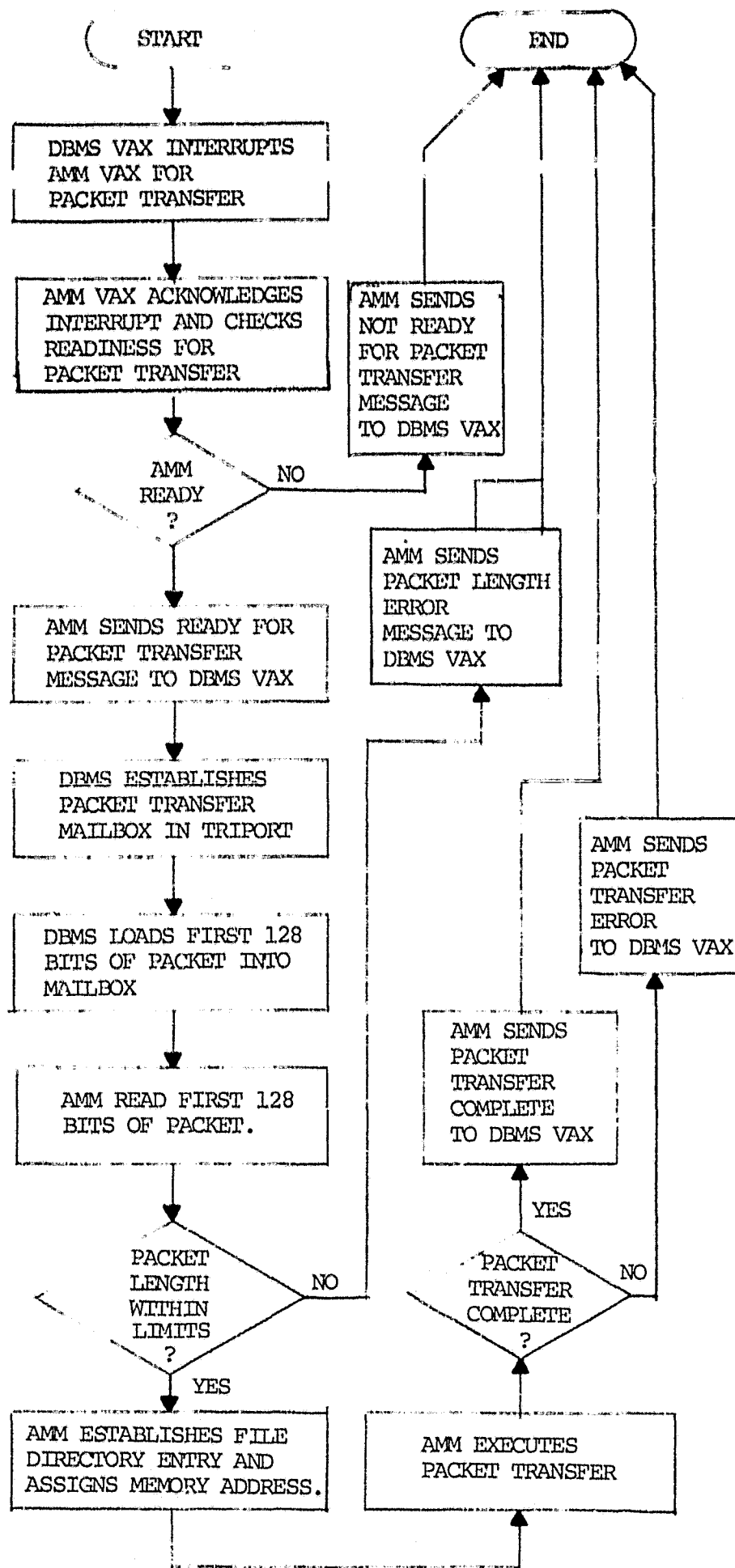


FIGURE 3.3.4.2. INPUT PROCESS (TRIPOINT TO AMM)

3.3.5 Output Scenario

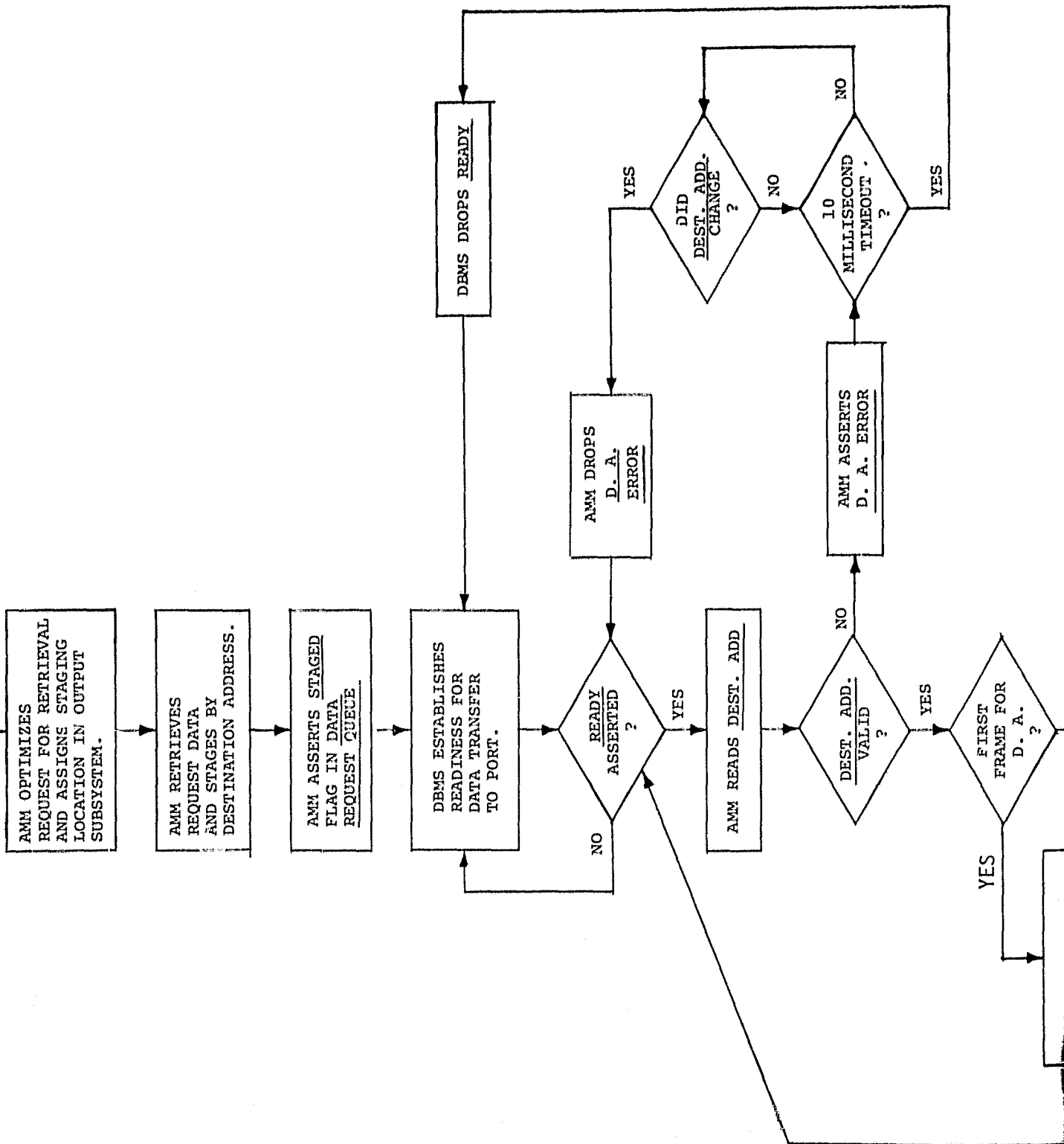
The AMM outputs data to the output high speed FOB port and the low speed triport. Data to be output from the AMM archival or temporary storage files to either output port is requested by the DBMS in the format discussed in Section 3.3.3.5. The AMM file manager translates the requests into the storage locations and optimizes request servicing to minimize the time required to retrieve a set of data requests. In order to provide responsive output to a variety of low and high speed users, the AMM shall employ a prestaged buffered output concept. This concept shall be based upon the following assumptions:

1. Requests for small records and small quantities of data are normally made by relatively slow speed users.
2. Small requests may be output either via the triport or via the high speed FOB.
3. Requests for large records or large quantities of data are normally made by relatively high speed users.
4. Large requests shall normally be output via the high speed FOB.
5. Each request has one destination address.

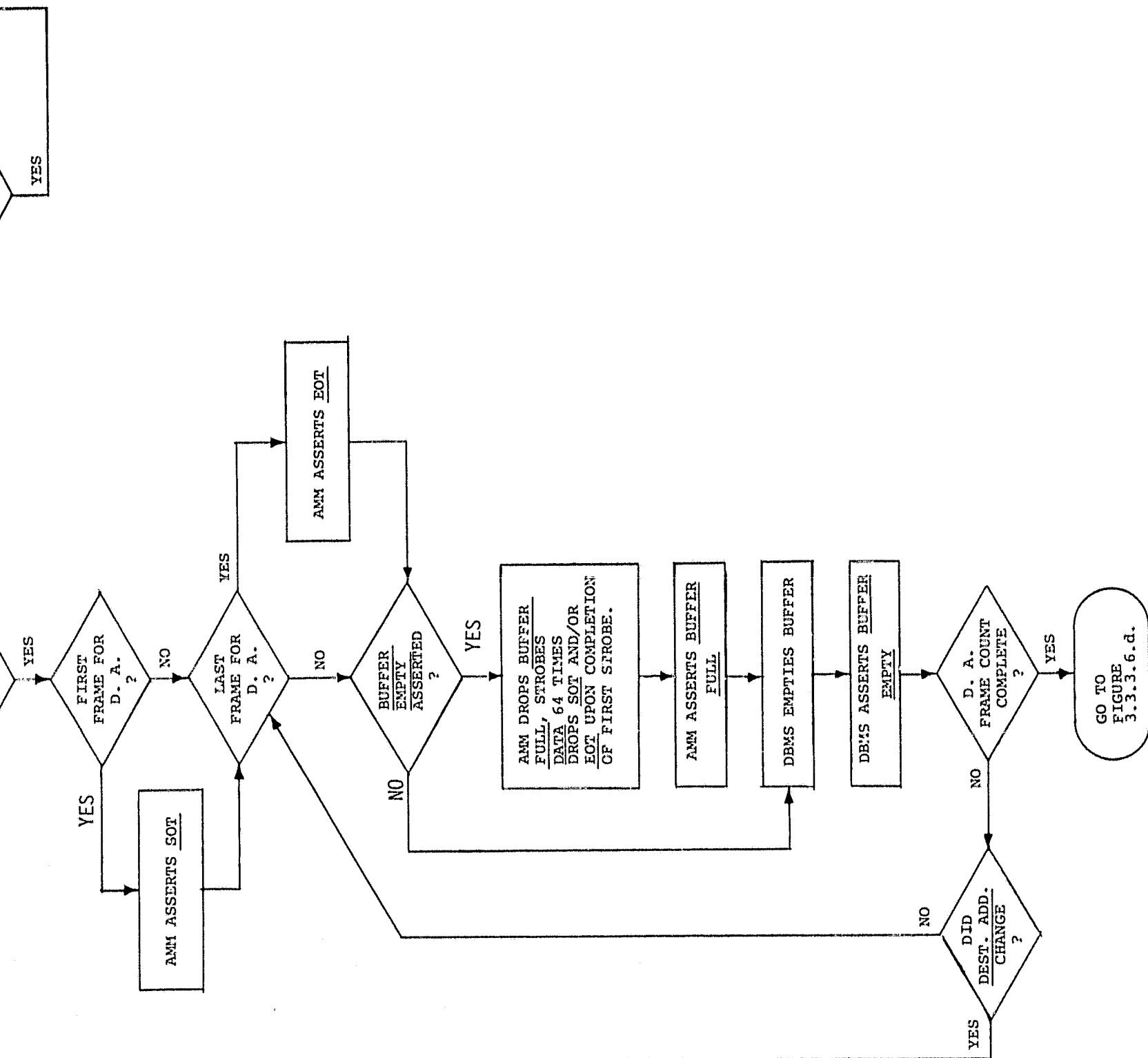
3.3.5.1 Output via FOB

Output data format and transfer are discussed in Sections 3.3.2.6.1 and 3.3.2.6.2 respectively. Figure 3.3.5.1 depicts the process.

FROM
FIGURE
3.3.3.6.d.



FOLDOUT FRAME



FOLDOUT FRAME 2

OUTPUT PROCESS (VIA FOB PORT)
FIGURE 3.3.5.1.

3.3.5.2 Output via Triport

Output data format and transfer are discussed in Sections 3.3.2.6.3 and 3.3.2.6.4 respectively. Figure 3.3.5.2 depicts the process.

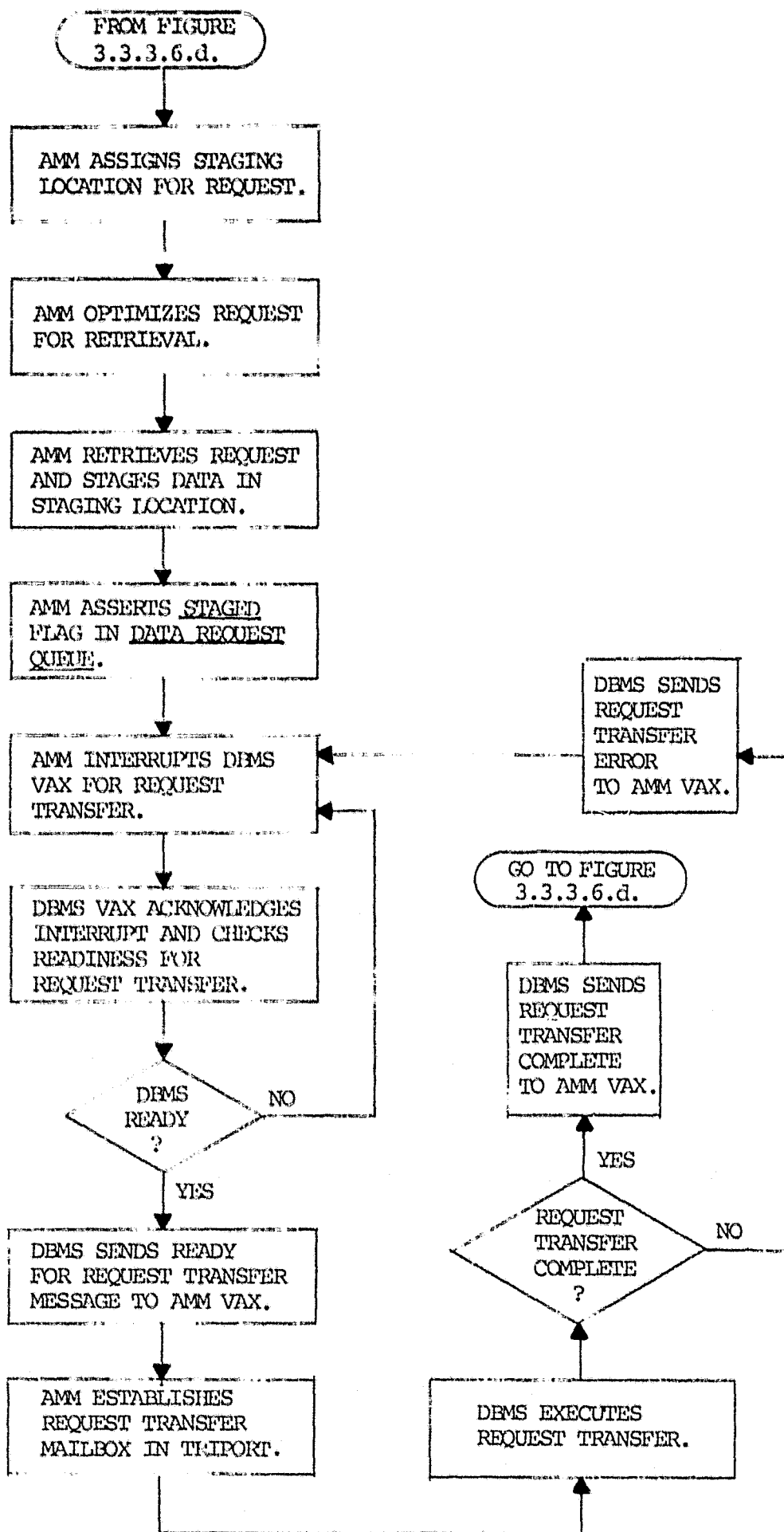


FIGURE 3.3.5.2. OUTPUT PROCESS (AMM TO TRIPORT)

4.0 FACILITIES

4.1 Facilities Interface Definition

This section defines the Facilities Interfaces required for AMM-13 day-to-day operations. The interfaces discussed are the normal ranges of operation for Power, Air Conditioning and Facilities Layout (floor space, receptacle location, ducts location), as well as peculiar items such as Water Drainage, and Lighting associated with the AMM-13 Fiche Processor and Replicator equipment. Also defined is the cable length required for the AMM-13 - DBMS - Computer Interconnect.

4.2 Basic Concept

The concepts are simple and in accordance with standard practices for a computer system environment pertaining to power, air conditioning, and floor space as recommended by the computer manufacturers in their various equipment and user manuals. (See in particular - Applicable Documents, DEC Installation Guide).

4.3 Details

4.3.1 Power

4.3.1.1 Definition

This section outlines the typical AC receptacles and type power required to power-on each of the cabinets of the various AMM-13 subsystems. The required power and associated protective circuit breakers and receptacles will be provided by Harris for acceptance test at the factory and by MSFC for assembly and test at MSFC. These items are detailed in DEC and HARRIS Installation Guides, but in general consist of the items outlined in paragraph 4.3.1.2 below.

4.3.1.2

AMM-13 Subsystem's Power Distribution Outline

a. COMPUTER SUBSYSTEM

<u>ITEM (Quantity)</u>	<u>115V-1Ø</u>	<u>208V-3Ø</u>	<u>AMPS</u>	<u>Btu/hr</u>	<u>SPECIAL RECEPTACLE</u>	<u>INDIV. C.B.</u>
CPU (1)	NO	YES	30	21330	NEMA # L21-30 P	YES
EXT. CABINET (2)	NO	YES	30	6820	NEMA # L21-30 P	YES
TAPE						
CABINET (1)	YES	NO	30	3100	NEMA # L5-30P	YES
DISK						
CABINET (2)	NO	YES	20	7170	NEMA #L21-20P	YES
(DRV. MOTORS)						
SMALL						
PERIPHERALS						
2 CRT's	YES	NO	15 ea	1024	NEMA # 5-1P DISTRIBUTED (512 ea)	
1 LA120	YES	NO	15	1500	NEMA # 5-1P	

b. INPUT/OUTPUT/VERIFY SUBSYSTEMS

ITEM (Quantity)	115V-1Ø	208V-3Ø	AMPS	Btu/hr	SPECIAL RECEPTACLES	INDIV. C.B.
CABINET (2)	YES	NO	30	10,000	NEMA # L21-30 P	YES
DISK DRIVES (4)	NO	YES	20	6,820	NEMA # L21-20 P	YES

c. REMAINING SUBSYSTEMS

ITEM (Quantity)	115V-1Ø	208V-3Ø	AMPS	Btu/hr	SPECIAL RECEPTACLES	INDIV. C.B.
RECORDER (2)	NO	YES	30	6,000	NEMA # L21-30 P	YES
S & R (2)	NO	YES	30	6,000	NEMA # L21-30 P	YES
FICHE DEVELOPER(1)	NO	YES	20	10,000	NEMA # L21-30 P	YES
REPLICATOR (1)	NO	YES	30	4,000	NEMA # L21-30 P	YES

TOTAL EQUIPMENT Btu/hr = 140,214

An additional 500 Btu/hr shall be added to the above per operator present in the facility area, as well as an additional amount for lighting (TBD).

Each of the Equipment listed provides a front panel power on-off switch and indicator for simple turn on and turn off by the operator.

The power cables shall not exceed 10 feet and receptacles shall be located as indicated in Figure A-1, The Facilities Layout Diagram.

All computer equipment shall provide at least 3 feet between the cabinets and walls for maintenance and repair. All other equipment shall be located as indicated in the Facilities Layout Diagram.

4.3.2 Air Conditioning

4.3.2.1 Definition

This section defines the temperature and humidity parameters for the VAX-11/780 computer to be used for AMM-13. It is anticipated that all AMM-13 Subsystems will occupy the same environment. (For ducting, see Facilities Layout below).

4.3.2.2 Temperature and Humidity

- a. Temperature - The operational temperature range suggested by DEC based on the VAX 11/780 System Environment shall be 65° F minimum to 75° F maximum.
- b. Humidity - The operational relative humidity conditions suggested by DEC based on the same units is 40% minimum to 60% maximum NON-CONDENSING.

4.3.3 Equipment Items

4.3.3.1 Definition

This section defines peculiar equipment facilities interfaces required for AMM-13 such as Water, Drainage, Lighting, and Computer Interconnects (Data Cabling).

4.3.3.2 Water

The AMM-13 shall require a deionized filtered water supply with a flow rate of at least 4.5 gallons per minute at 45 lbs./square inch pressure with a maximum temperature of the cold water supply of 78°F for cooling and processing undeveloped fiche in the Fiche Processor Subsystem.

TABLE 1

IMPURITY	MAXIMUM OR RANGE OF CONTENT (ppm*)
Color and suspended matter	None
Dissolved Solids	250
Silica	20
pH	7.0 to 8.5
Hardness, as calcium carbonate	40 (preferable) to 150
Copper, Iron, Manganese (each)	0.1
Chlorine, as free hypochlorous acid	2
Chloride	25
Bicarbonate	150
Sulfate	200
Sulfide	0.1

*parts per million

4.3.3.3 Drainage

Drainage shall be provided to handle a minimum flow rate of 4.5 gallons per minute.

4.3.3.4 Refrigeration

The facility shall provide refrigeration storage for undeveloped film of 1 cu. ft. for a period of 3 months.

4.3.3.5 Lighting

No special safelights are required for routine operation of the AMM-13 system. Normal office lighting is sufficient.

4.3.3.6 Computer Interconnect

The data cable for the AMM-13-DBMS Computer Interconnect via the Tri-Port shared memory shall be from the DBMS VAX computer to the AMM-13 VAX computer and shall not exceed 10' in length. The physical relationship of these two computers shall be as indicated in the Facilities Layout Drawing Figure 4.3.4.2.1.

4.3.4 Facilities Layout

4.3.4.1 Definition

This section defines the floor space anticipated for AMM-13 as well as the layout for floor space, ducts, receptacles, and all equipment items. (The Facilities Layout remains fluid and is appended to this document. It is anticipated that the Facilities Layout shall be incorporated as part of this document by CDR).

4.3.4.2 Floor Space

Figure 4.3.2.2.1 approximates the floor space required by AMM-13. Offset floors shall be designed for distributed loads of 200 lbs/ft² and a concentrated load of 1000 lbs/ft². The distribution of air-conditioning ducts, receptacles, water, and drainage shall be as indicated in the Facilities Layout Drawing A-1.

5.0

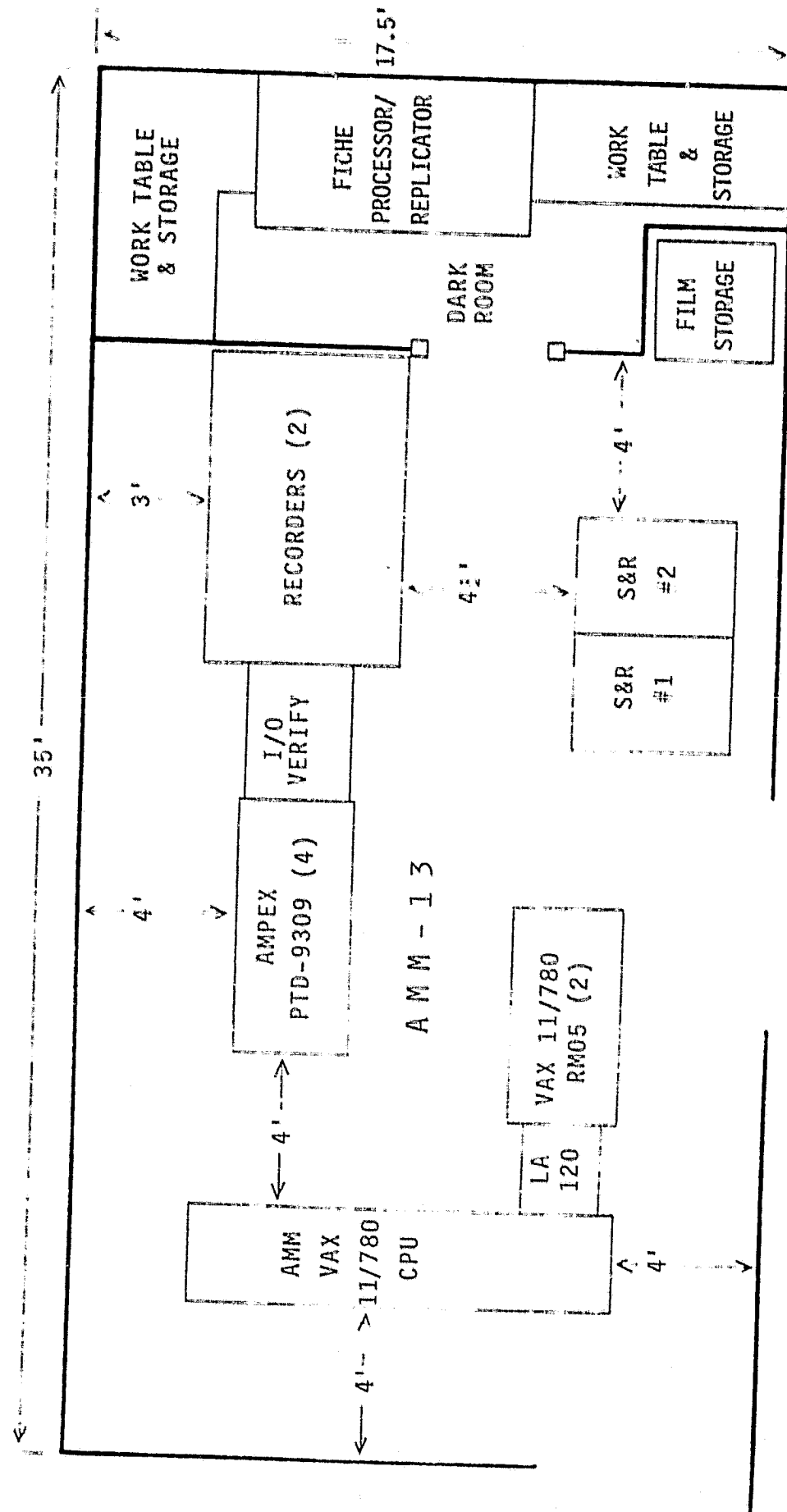
LIST OF ILLUSTRATIONS

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pg. 48	Figure A-1	Facilities Layout
pg. 49	Figure A-2	Facility Work Areas

APPENDIX A

FACILITIES LAYOUT DIAGRAM

FACILITIES LAYOUT

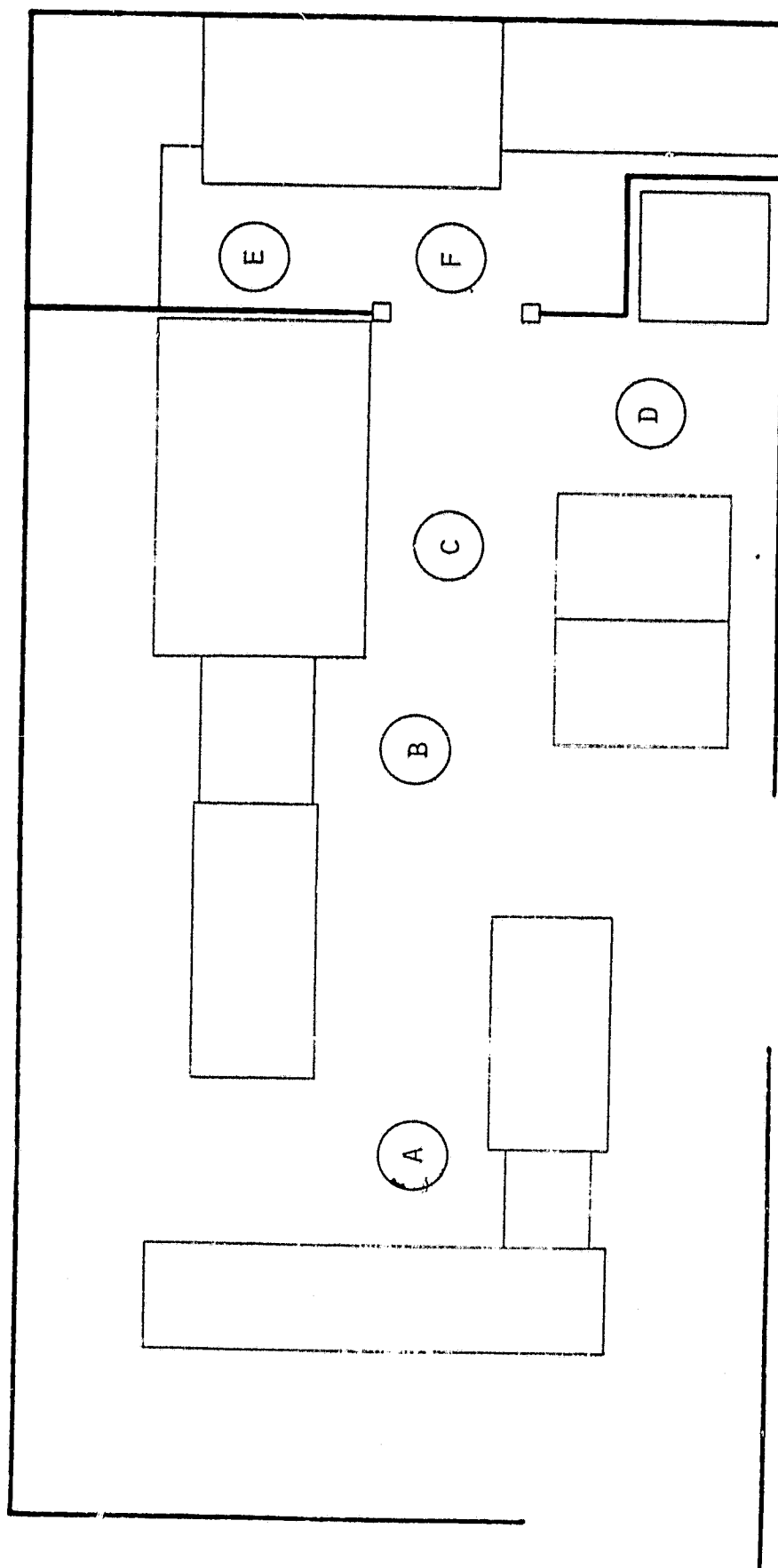


NOTE: ALL DISTANCES ARE APPROXIMATE

Figure A - 1

FACILITY WORK AREAS

- A. CPU SETUP, DEBUG
- B. I/O VERIFY CHECK, SETUP/S&R FICHE INSERT & OPERATE
- C. RECORDER FILM MAG. INSERT/S&R FICHE INSERT
- D. RETRIEVE STORED FILM MAG.



- E. DARKROOM LOAD FILM MAG./PROCESS FILM
- F. SAME AS E.

Figure A - 2